Iowa Infiltration and Ksat Studies

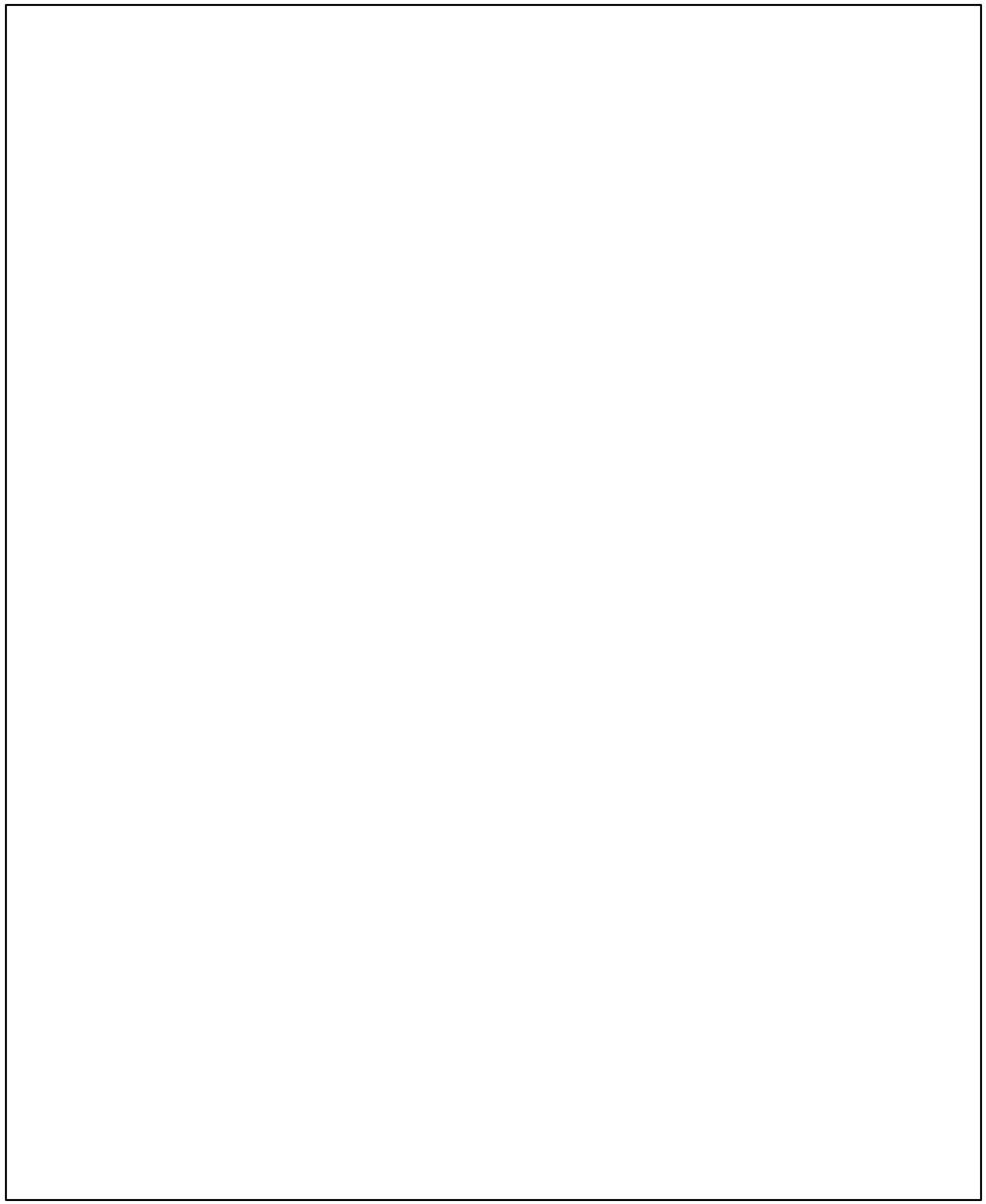
Thanos Papanicolaou and Lee Burras
IIHR - Hydroscience & Engineering
The University of Iowa

Dept. of Agronomy
Iowa State University

IIHR Hydroscience & Engineering

Waterscape

Soilscape



Definition

- Hydraulic conductivity can be defined as a measure of the ability of soil to transmit water. At saturation state, this parameter is denoted as K_s and assumed to be constant for a given space and time within a soil continuum.

Objective

Long term objective: **PTFs**

Pedo **T**ranfer **F**unctions

For clay content ≤ 40%

$$K_{sat} = -0.265 + 0.0086\,(100\,sand\,)^{1.8} + 11.46\,CEC^{\,-0.75} \quad ------(1a)$$

For clay content > 40%

$$K_{sat} = 0.0066e^{(2.44/clay)} \quad --------(1b)$$

where

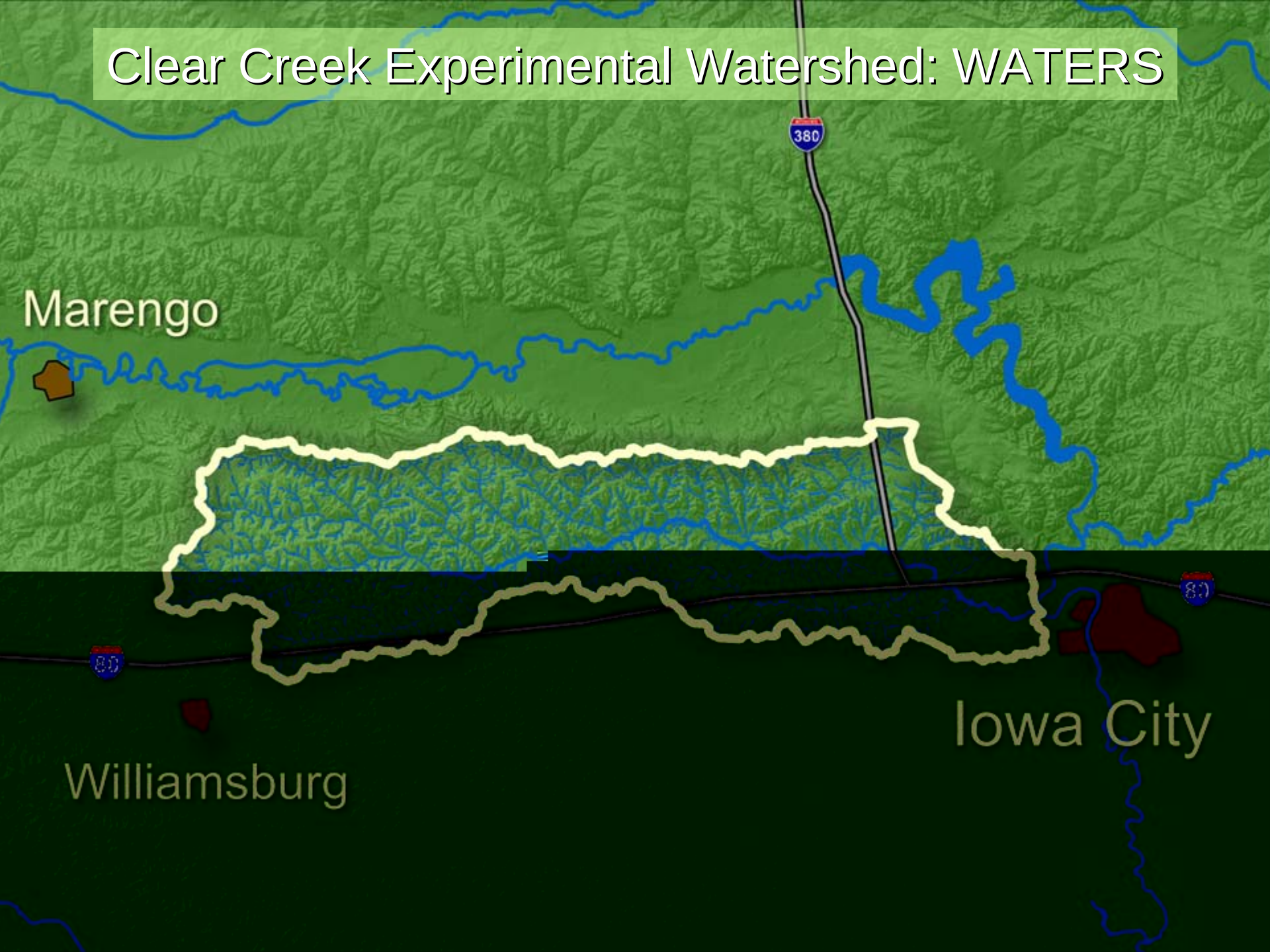
sand and clay are the fractions (%) of sand and clay, and CEC (meq/100g) is the cation exchange capacity of the soil.

Long term objective

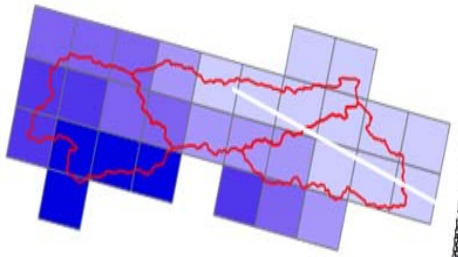
We have enjoyed great successes but there are also yawning gaps between how well soil functions are performed and how well they need to be.

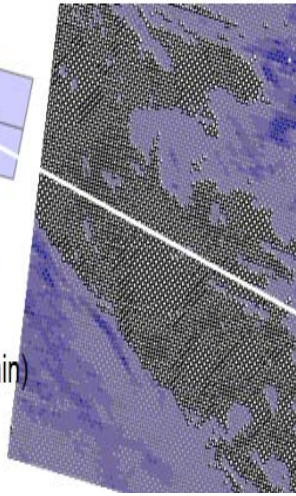
Knowing the range of variability of key dynamic parameters

Such as Ksat will allow us to assess the role of human-impacts on soil quality


Clear Creek Experimental Watershed: WATERS
380
Marengo
80
80
Iowa City
Williamsburg

Clear Creek

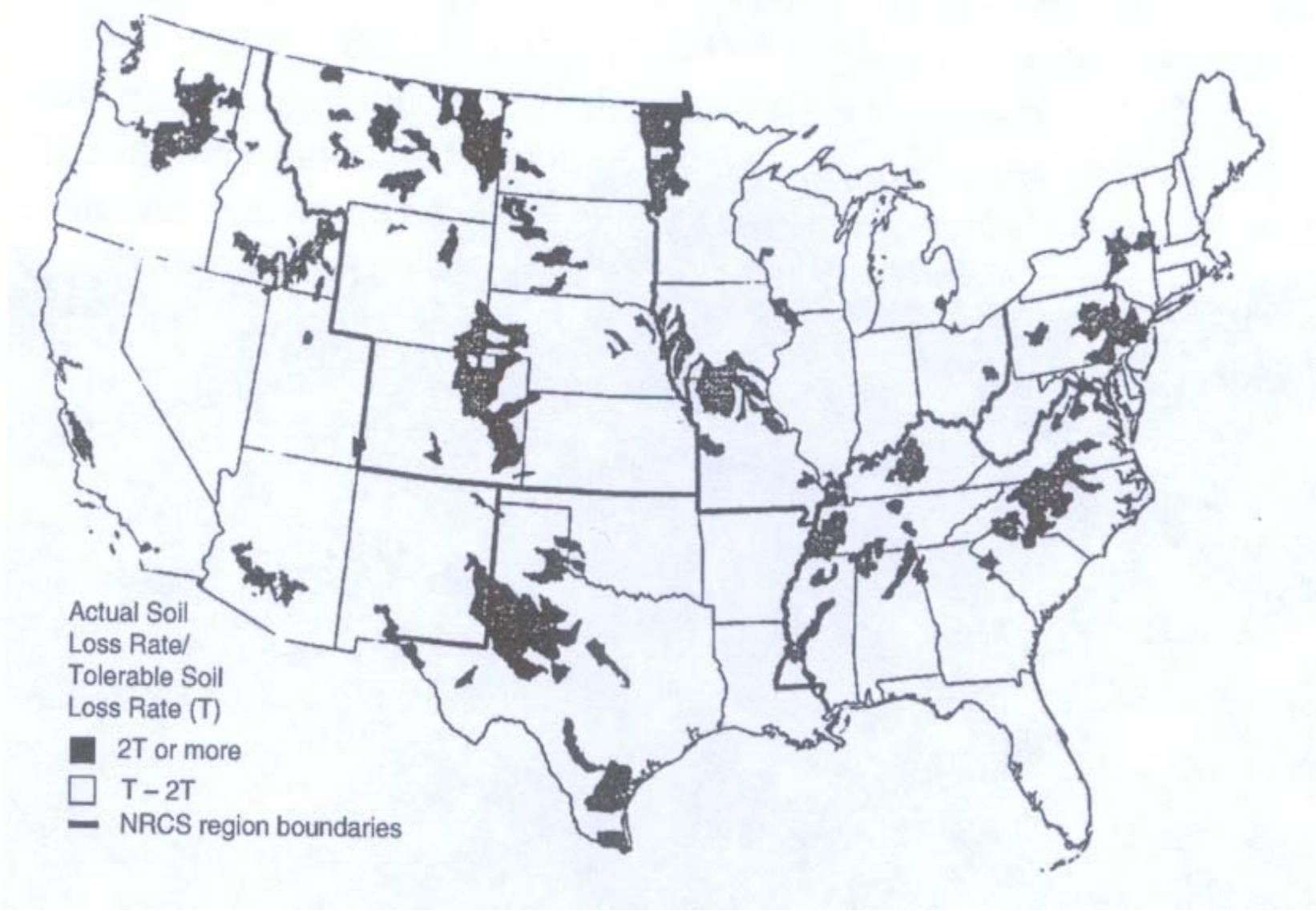




Data source 1: Iowa Mesonet (**daily**)

Data source 2: UI HydroNEXRAD(1 min)

Nowhere is this program more appropriate than in Iowa, which is under increasing pressure to compromise its fragile soil and water assets to maximize agricultural production of all available land.



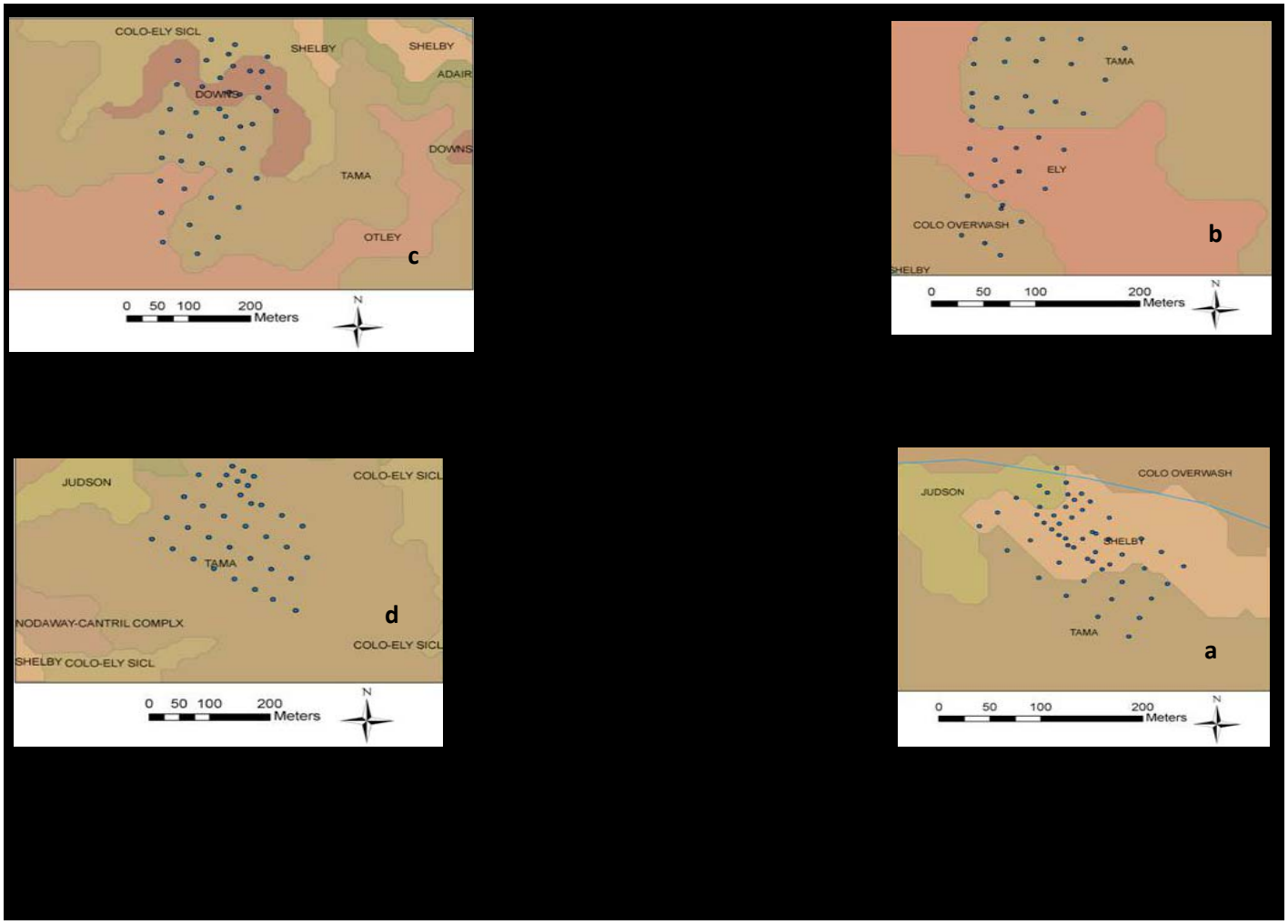
Approach

Instrumentation

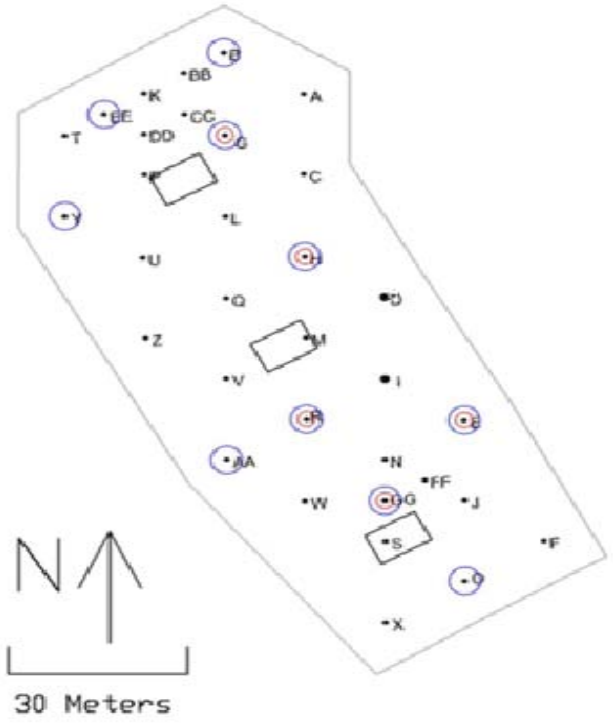
The automated Amoozemeter and DRI

Experimental Matrix

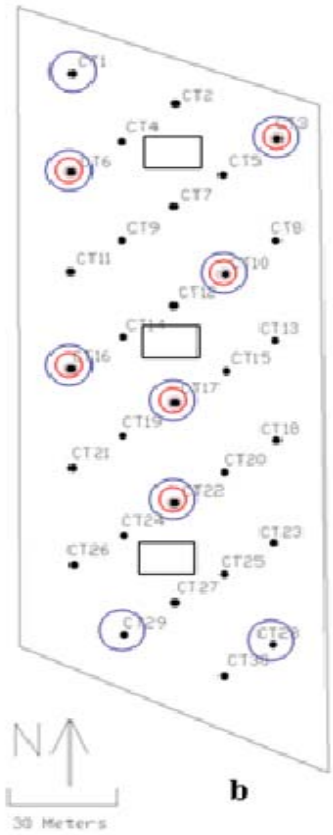
Examples of spatially distributed measurements



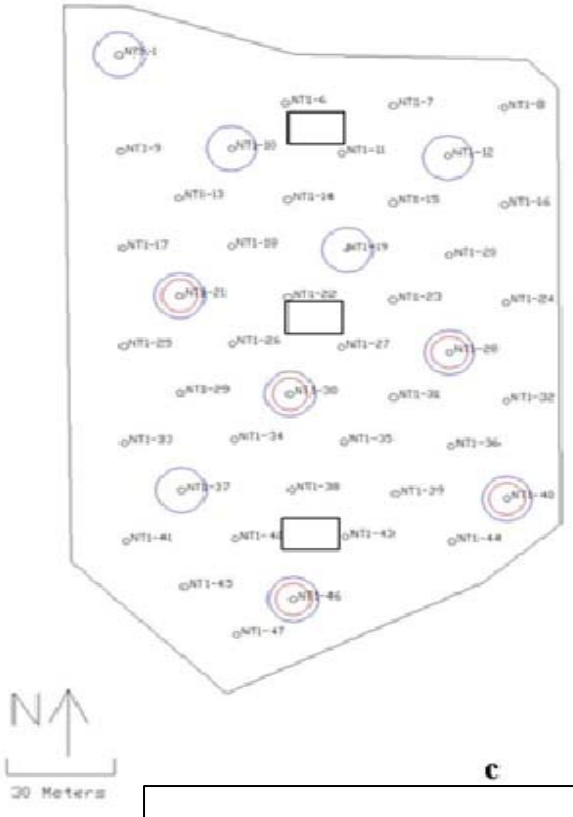
Repeated measurements



a

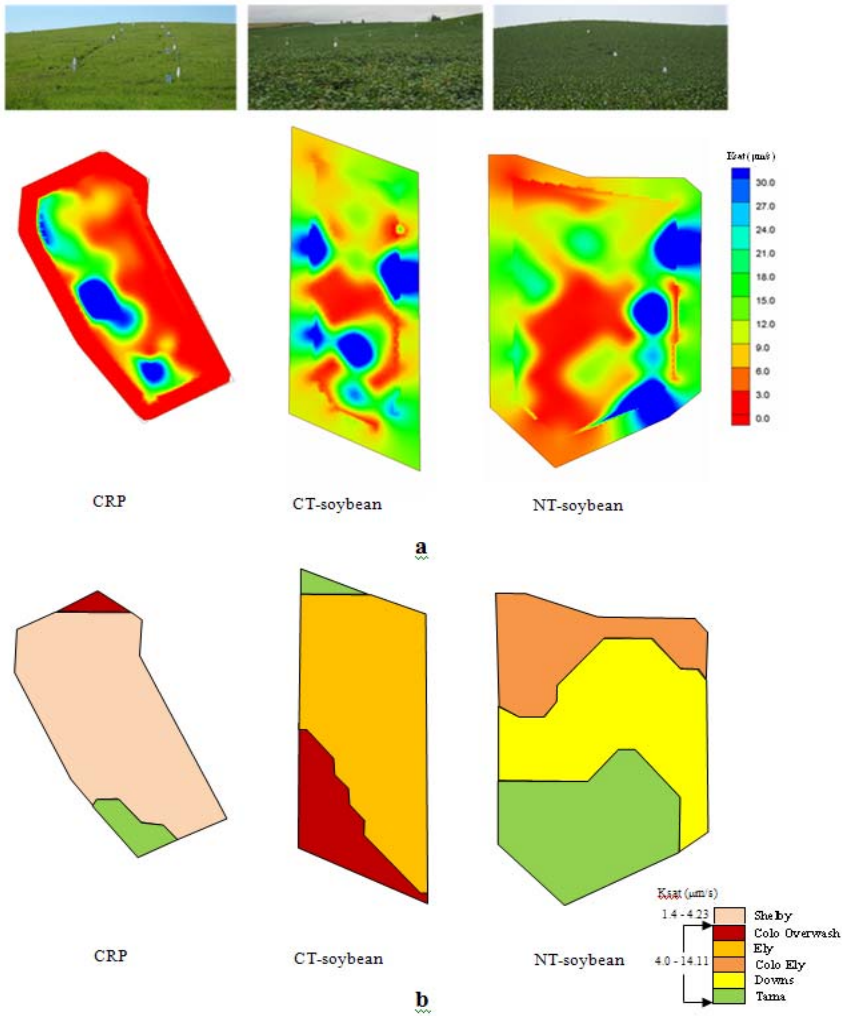


b



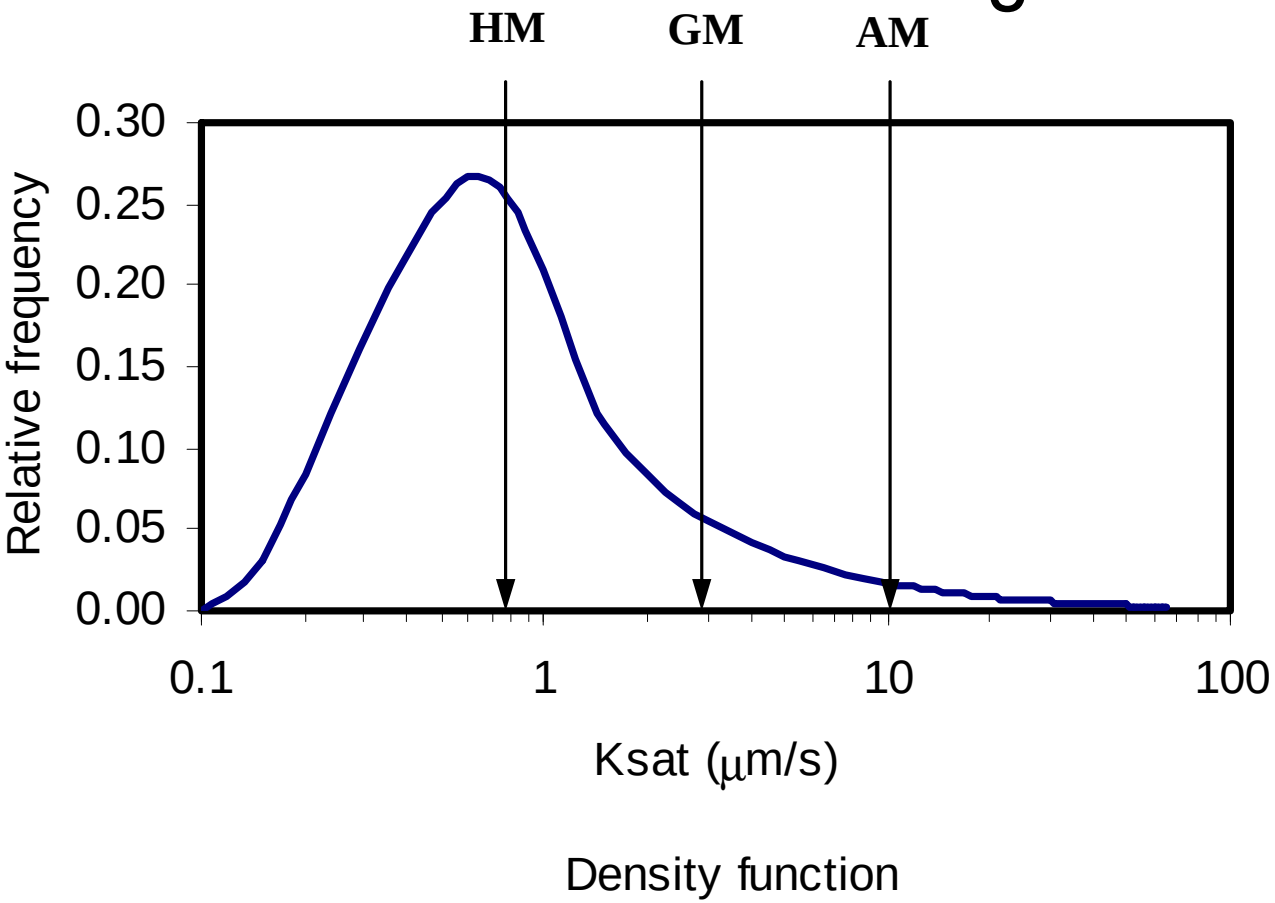
c

Finding 1


Kfat (μm/s)
30.0
27.0
24.0
21.0
18.0
15.0
12.0
9.0
6.0
3.0
0.0
CRP
CT-soybean
NT-soybean
a
CRP
CT-soybean
NT-soybean
b
Kfat (μm/s)
14 - 423
40 - 1411
Shelby
Colo Overwash
Ely
Colo Ely
Downs
Tama

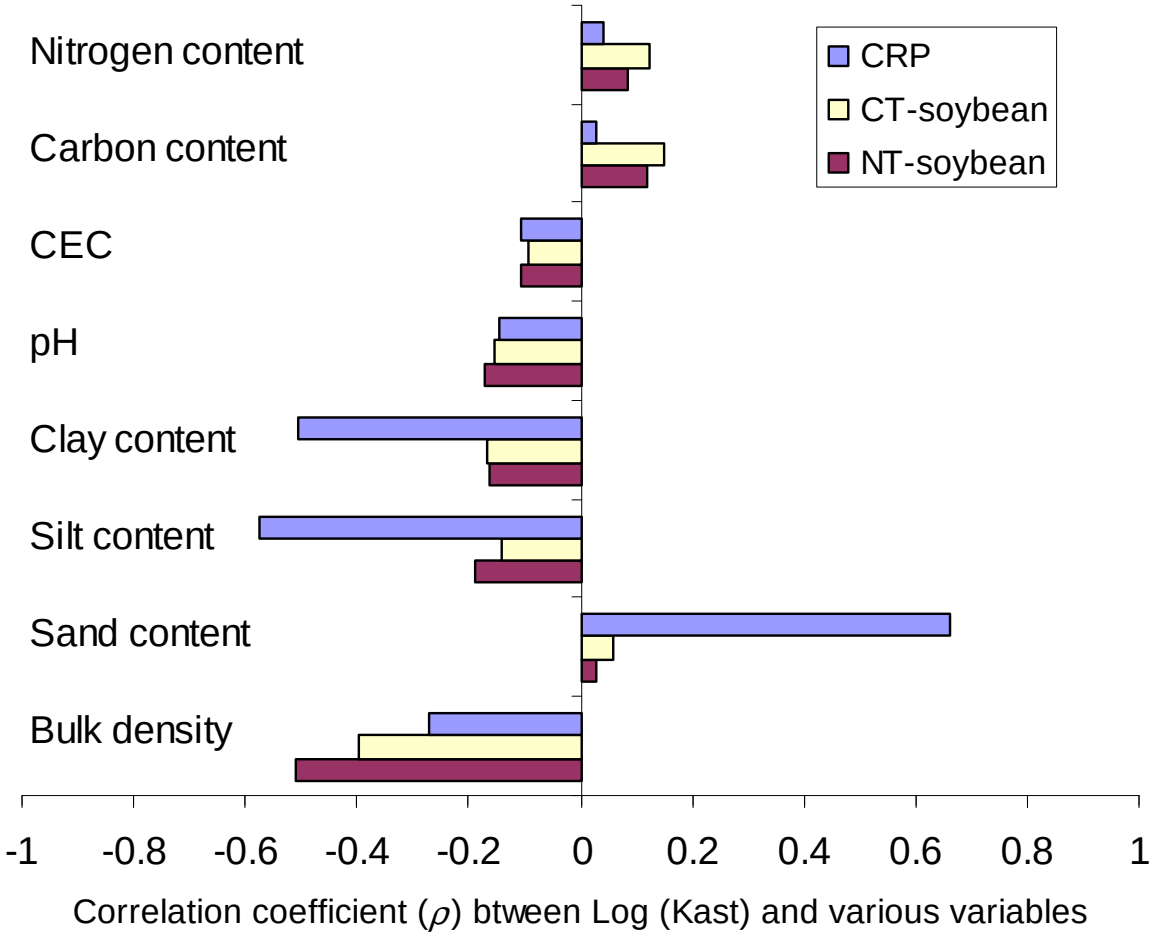
Finding 2

Finding 3



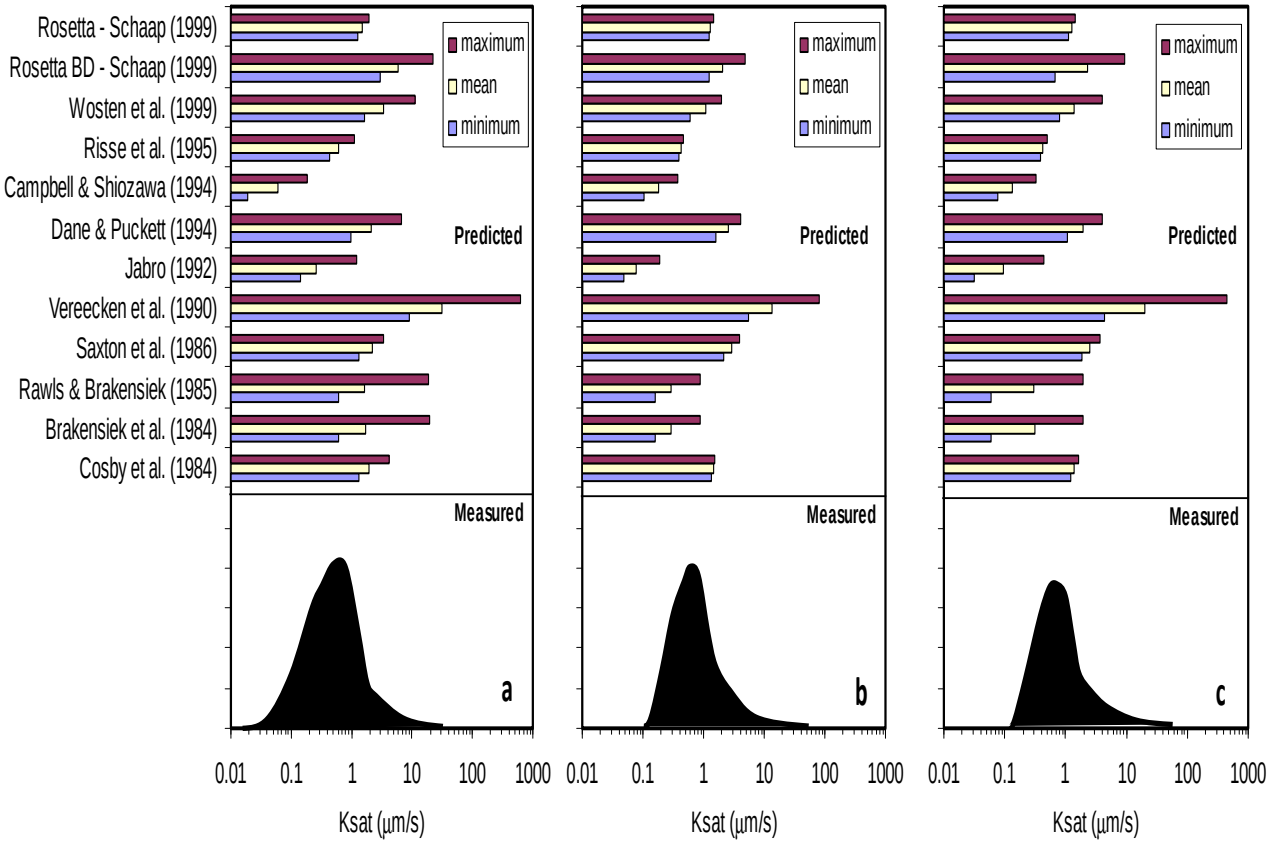
Density function

Finding 4


Nitrogen content
Carbon content
CEC
pH
Clay content
Silt content
Sand content
Bulk density
CRP
CT-soybean
NT-soybean
-1
-0.8
-0.6
-0.4
-0.2
0
0.2
0.4
0.6
0.8
1
Correlation coefficient (ρ) btween Log (Kast) and various variables

En route ..to Finding 5

Finding 5


Rosetta - Schaap (1999)
Rosetta BD - Schaap (1999)
Wosten et al. (1999)
Risse et al. (1995)
Campbell & Shiozawa (1994)
Dane & Puckett (1994)
Jabro (1992)
Vereecken et al. (1990)
Saxton et al. (1986)
Rawls & Brakensiek (1985)
Brakensiek et al. (1984)
Cosby et al. (1984)
maximum
mean
minimum
Predicted
Measured
a
b
c
0.01
0.1
1
10
100
1000
Ksat (µm/s)

Finding 6

PTF/Input variables	% sand	% silt	% clay	Bulk density / Porosity	CEC	OM
Cosby et al. (1984)	×		×			
Brakensiek et al. (1984)	×		×	×		
Saxton et al. (1986)	×		×			
Rawls and Brakensiek (1985)	×		×	×		
Vereecken et al. (1990)	×		×			×
Jabro (1992)		×	×	×		
Dane and Puckett (1994)			×			
Campbell and Shiozawa (1994)	×		×			
Risse et al. (1995)	×				×	
Wosten et al. (1999)		×	×	×		×
Rosetta BD - Schaap (1999)	×	×	×	×		
Rosetta - Schaap (1999)	×	×	×			

Topics of discussion

- How can we use remote data to make direct inferences about the soil type.
- Utilize different PTFs around the Nation (e.g., North Wisconsin Till).
- Rainfall experiments to develop relationships among CN and Ksat- expand on that relation since CN is a common index.

- Deep measurements & Soil structure (see e.g., Larry West study in Catena)
- Parent material composition
- Stable macropores (less shrinkage and swelling potential) (X-ray CT studies) and role of compaction
- Erosion but also biochar applications can control Ksat
- Geometric mean versus arithmetic and harmonic mean

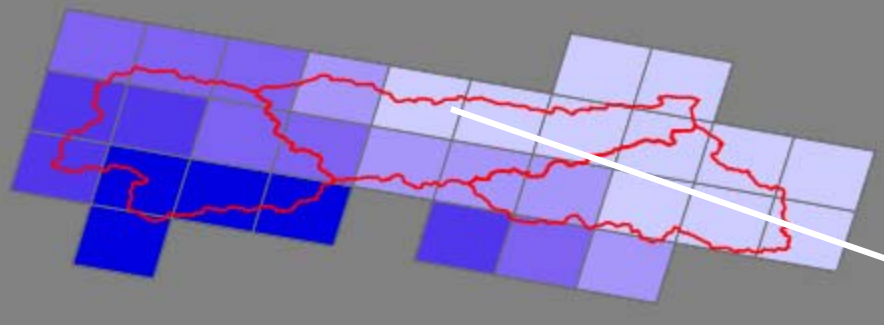
Topics of discussion

DW Application: Rainfall from NEXRAD

Upper

Middle

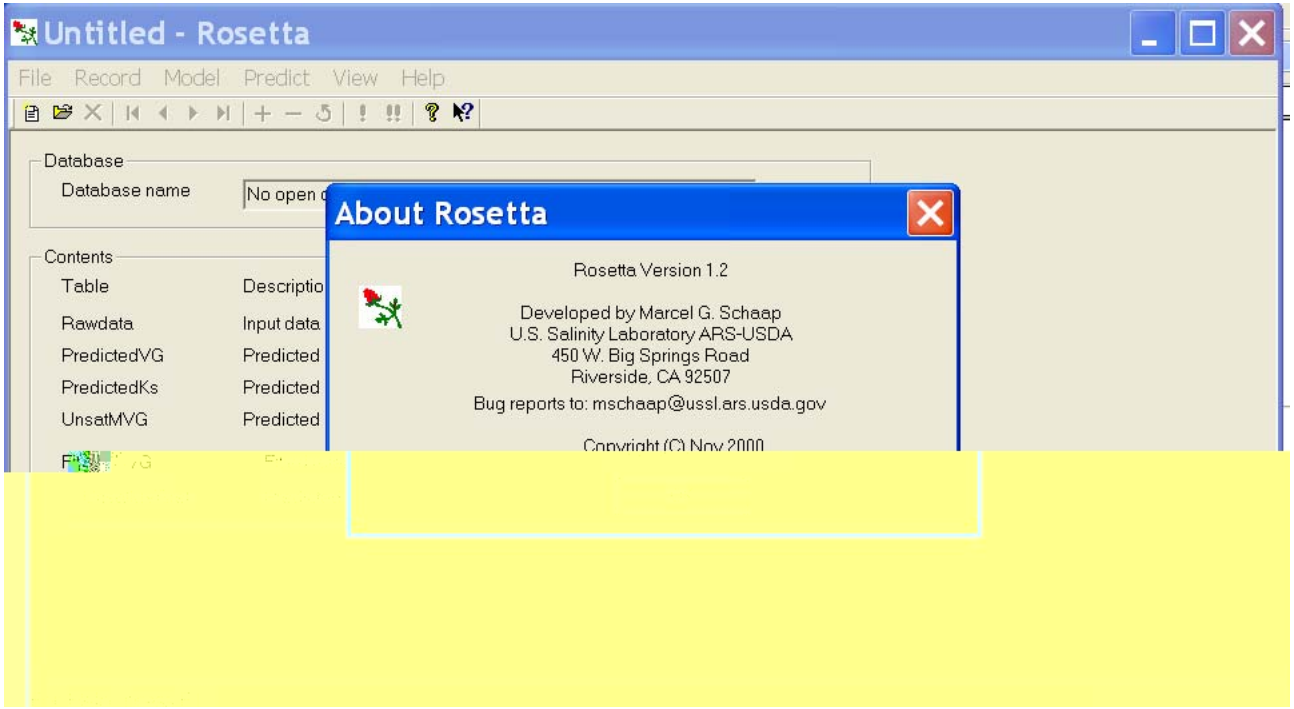
Lower



Data source 1: Iowa Mesonet (**daily**)

Data source 2: NOAA (**5 min)**

http://ssldata.nrcs.usda.gov/advquery.asp



Iwa Infiltration and Ksat Studies

If you have any questions feel free to contact me

At

E-mail: apapanic@engineering.uiowa.edu